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Home > Country Analysis Briefs > **India: Environmental Issues**



PDF version | PDB version

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[Introduction](#) | [Air Pollution](#) | [Energy Consumption](#) | [Carbon Emissions](#)
[Energy and Carbon Intensity](#) | [Renewable Energy](#) | [Environmental Outlook](#)

India: Environmental Issues

Introduction

India's ongoing population explosion has placed great strain on the country's environment. This rapidly growing population, along with a move toward urbanization and industrialization, has placed significant pressure on India's infrastructure and its natural resources. Deforestation, soil erosion, water pollution and land degradation continue to worsen and are hindering economic development in rural India, while the rapid industrialization and urbanization in India's booming metropolises are straining the limits of municipal services and causing serious air pollution problems.

Following the 1984 Bhopal disaster - in which a toxic leak from the city's Union Carbide chemical plant resulted in the deaths of more than 3,000 people - environmental awareness and activism in India increased significantly. The Environment Protection Act was passed in 1986, creating the Ministry of Environment and Forests (MoEF) and strengthening India's commitment to the environment, which was enshrined in the 42nd amendment to country's constitution in 1976. Under the 1986 Environmental Protection Act, the MoEF is tasked with the overall responsibility for administering and enforcing environmental laws and policies. The MoEF established the importance of integrating environmental strategies into any development plan for the country.

Nevertheless, despite a greater commitment by the Indian government to protect public health, forests, and wildlife, policies geared to develop the country's economy have taken precedence in the last 20 years. While industrial development has contributed significantly to economic growth in India, it has done so at a price to the environment. Not only is industrial pollution increasing public health risks, but abatement efforts also are consuming a significant portion of India's gross domestic product (GDP). As such, one of MoEF's main responsibilities continues to be the reduction of industrial pollution.

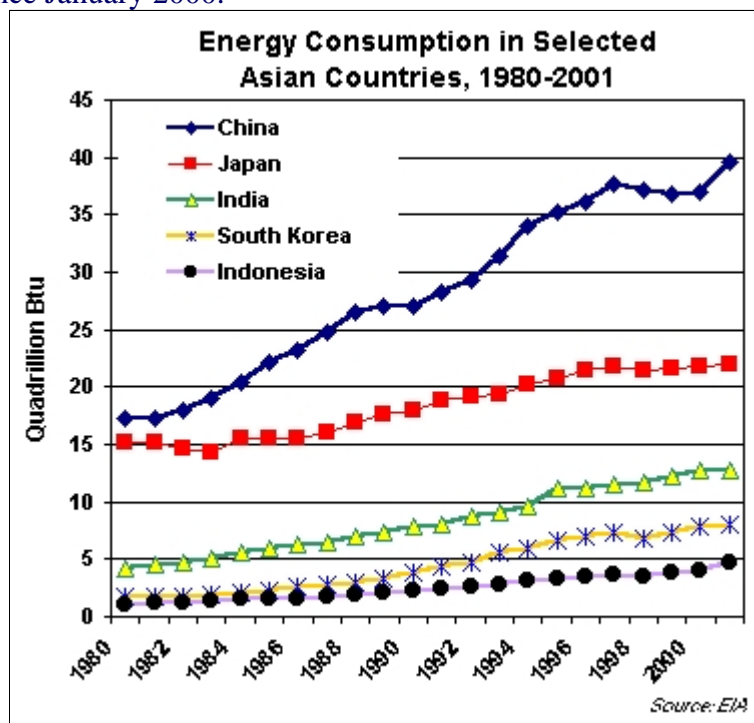
Air Pollution

Industrialization and urbanization have resulted in a profound deterioration of India's air quality. India has more than 20 cities with populations of at least 1 million, and some of them--including New Delhi, Mumbai, Chennai, and Kolkata--are among the world's most polluted. Urban air quality ranks among the world's worst. Of the 3 million premature deaths in the world that occur each year due to outdoor and indoor air pollution, the highest number are assessed to occur in India. Sources of air pollution, India's most severe environmental problem, come in several forms, including vehicular emissions and untreated industrial smoke. Continued urbanization has exacerbated the problem of rapid industrialization, as more and more people are adversely affected and cities are unable to implement adequate pollution control mechanisms.

One of the most affected cities in New Delhi, where airborne particulate matter (PM) has been registered at levels more than 10 times India's legal limit. Vehicles are the major source of this

pollution, with more than three million cars, trucks, buses, taxis, and rickshaws already on the roads. With vehicle ownership rising along with population and income, India's efforts to improve urban air quality have focused in this area. In New Delhi, emissions limits for gasoline- and diesel-powered vehicles came into effect in 1991 and 1992, respectively, and the city has prohibited the use of vehicle more than 15 years old. Emissions standards for passenger cars and commercial vehicles were tightened in 2000 at levels equivalent to the Euro-1 standards of the European Union, while the even-more-stringent Euro-2 standards have been in place for the metropolitan areas of Delhi, Mumbai, Chennai, and Kolkata since 2001. Furthermore, the sulfur content of motor fuels sold in the four cities has been restricted to 500 parts per million (PPM) since 2001 in order to be compatible with tighter vehicle emissions standards. Motor fuel sulfur content in all other regions of India has been limited to 2,500 PPM since January 2000.

India's high concentration of pollution is not due to the absence of a sound environmental legal regime, however, but to a lack of environmental enforcement at the local level. Regulatory reforms aimed at improving the air pollution problem in cities such as New Delhi have been difficult to implement. In 1998, India's Supreme Court issued a ruling requiring all the city's buses to be run on compressed natural gas (CNG) by March 31, 2001. Compliance was to be achieved either by converting existing diesel engines or by replacing the buses themselves. However, only 200 (out of a total fleet of 12,000) CNG-fueled buses were available by the initial deadline and public protests, riots, and widespread "commuter chaos" ensued as some appearance of some 15,000 taxis and 10,000 buses in the city were banned from use. To ease the transition, the local government changed course and allowed for a gradual phaseout of the existing diesel bus fleet.



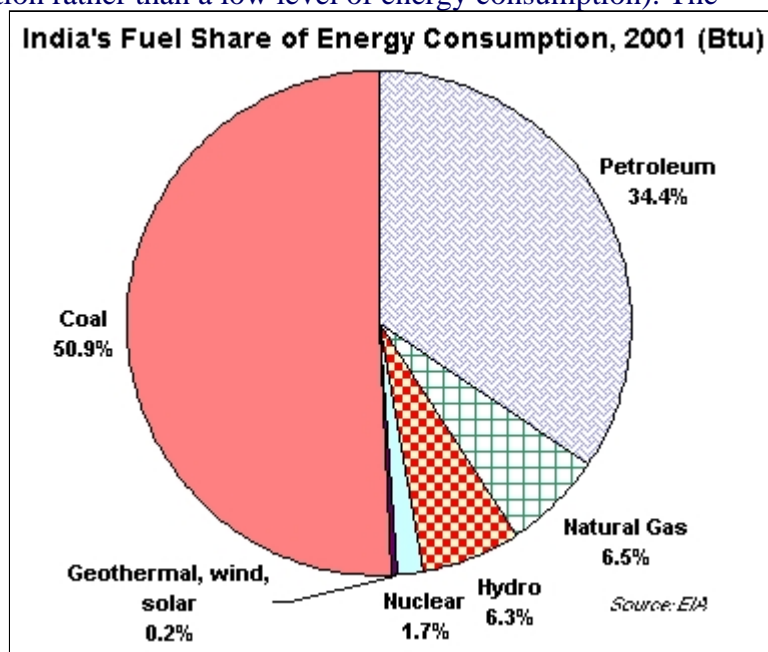
In addition, India's reliance on coal-fired power plants for its electricity generation has undermined some of the vehicular-oriented air quality improvement initiatives. Despite the fact that India is a large coal consumer, its Central Pollution Control Board has been slow to set sulfur dioxide (SO₂) emissions limits for coal-fired power plants, mainly because most of the coal mined in India is low in sulfur content. Coal-fired power plants do not face any nitrogen oxide (NO_x) emissions limits either, although thermal plants fueled by other fossil fuels are subject to particulate matter emission standards. Again, however, the government's support for air quality standards has been undermined by the lack of enforcement of these standards.

Energy Consumption

India's energy consumption is increasing rapidly, from 4.16 quadrillion Btu (quads) in 1980 to 12.8 quads in 2001. This 208% increase is largely the result of India's increasing population and the rapid urbanization of the country. Higher energy consumption in the industrial, transportation, and residential sectors continues to drive India's energy usage upwards at a faster rate even than China, which experienced a 130% increase in energy consumption from 1980 to 2001.

Despite the rapid growth between 1980 and 2001, India's energy consumption is still below that of Germany (14.35 quads), Japan (21.92 quads), China (39.67 quads), and the United States (97.05 quads). In addition, India's per capita energy consumption, which stood at 12.6 million Btu in 2001, is well below most of the rest of Asia and is one of the lowest in the world (although this may be more the result of India's large population rather than a low level of energy consumption). The 103% rise in India's per capita consumption between 1980, when per capita energy usage was just 6.2 million Btu, and 2001, is more problematic in the long-term, however.

Coal accounts for just over 50% (6.5 quads) of India's energy consumption. The power generation sector uses the majority of this coal, with heavy industry a distant second. Petroleum (4.4 quads) makes up 34.4% of India's energy consumption, while natural gas (6.5%) and hydroelectricity (6.3%) account for much of the remainder. Natural gas is growing in importance, as its share of India's energy consumption has risen from just 1.4% in 1980, while hydroelectricity - which made up 11.5% of the country's energy usage in 1980 - has declined in relative importance. Nuclear (1.7%) and geothermal, wind, solar, and biomass (0.2%) made up a very small share of the country's energy consumption in 2001.



Carbon Emissions

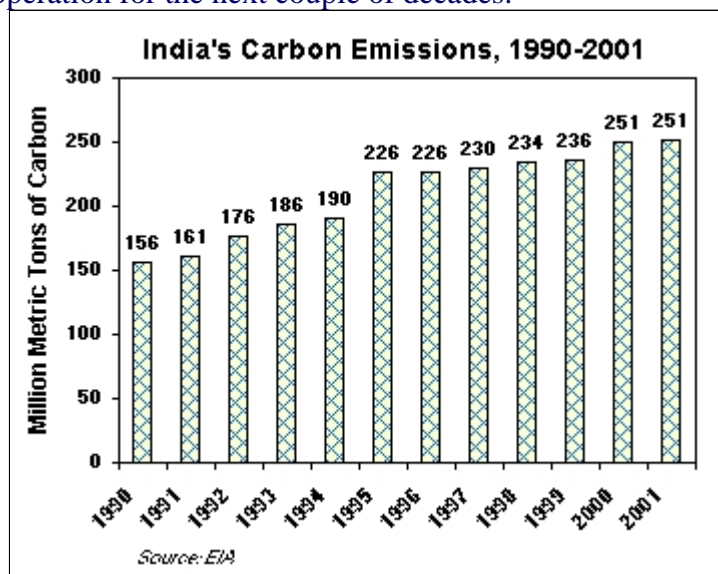
In 1992, India signed the United Nations Framework Convention on Climate Change as a non-Annex I country, meaning it is not obligated to reduce its emissions of carbon and greenhouse gases (GHG). India ratified the agreement in 1993. While India recognizes the importance of reducing these harmful emissions, the Indian government also places a high priority on economic development. As such, India is not a signatory to the Kyoto Protocol that mandates specific commitments by countries to reduce their emissions of greenhouse gases by an average of 5.2% below 1990 levels by the agreed 2008-2012 time frame. Nevertheless, India accepted (ratification was unnecessary) the Kyoto Protocol on August 26, 2002.

India's non-participation in the Kyoto Protocol has been cited as a major reason behind the opposition to implementing the Protocol by several signatories, including the United States. In 2001, India, with 251 million metric tons of carbon equivalent emitted, ranked fifth in the world in carbon emissions, behind the United States, China, Russia and Japan. Although India's carbon emissions stood at only 80% of Japan's (316 million metric tons of carbon equivalent) total and less than one-sixth of the United States' (1,565 million metric tons) carbon emissions that same year, the rapid growth of India's carbon emissions - in combination with its exclusion from the Protocol - is the main point of controversy.

Between 1990 and 2001, India's carbon emissions increased by an astonishing 61%, a rate surpassed only by China's 111% increase during the same time period. India's carbon emissions are expected to continue to increase throughout the decade, offsetting the planned reduction in GHGs from the

European Union and other countries that plan to implement the Protocol's emissions cut requirements. The rise in India's carbon emissions has been exacerbated by the low energy efficiency of coal-fired power plants in the country. With the high capital costs associated with replacing existing coal-fired plants, a scarcity of capital, and the long lead time required to introduce advanced coal technologies, it stands to reason that many of India's highly-polluting coal-fired power plants will have to remain in operation for the next couple of decades.

As such, India's contribution to world carbon emissions is expected to increase in coming years, with an estimated average annual growth rate between 2001 and 2025 of 3.0% in the EIA International Energy Outlook 2003 reference case (compared to 3.4% in China and 1.5% in the United States). The absolute increase in emissions will partially be a function of the degree to which coal is relied upon as a major energy source. If coal consumption is substituted by oil and natural gas consumption, India's overall carbon emissions would be reduced.



India's per capita carbon emissions are relatively low - at 0.25 metric tons of carbon per person in 2001, India's per capita carbon emissions were less than one-quarter of the world average and 22 times less than the United States. However, the country's per capita carbon emissions are expected to increase in the coming years due to the rapid pace of urbanization, a conversion away from noncommercial towards commercial fuels, increased vehicular usage and the continued use of older and more inefficient coal-fired plants. In fact, due to fast-paced industrialization, per capita emissions are expected to triple by 2020.

Energy and Carbon Intensity

In 2001, India's energy intensity (energy consumption per dollar of GDP) stood at 25,307 Btu per \$1995. Although this figure is one of the highest in Asia, surpassed only by Pakistan (26,229 Btu per \$1995) and China (35,619 Btu per \$1995), India's carbon intensity has remained relatively flat over the past 20 years, even falling from a high in 1995 (30,459 Btu per \$1995) back below 1980 level (25,861 Btu per \$1995). By contrast, China's energy intensity level in 2001 was just one-third of its 1980 level of 105,632 Btu per \$1995. India's still elevated energy intensity level is due in large part to the growth of energy-intensive industries that has taken place in the country during the course of its economic expansion, coupled with the virtual absence of energy efficiency and conservation measures in most industrial sectors.

Carbon intensity (carbon emissions per dollar of GDP) in India also is relatively high compared to its neighbors. In 2001, India's carbon intensity measured 0.5 metric tons of carbon per thousand \$1995. In Asia, only China's carbon intensity (0.75 metric tons of carbon per thousand \$1995) was higher than that of India, but whereas China has become less carbon intensive over the past 20 years, India's carbon intensity has remained at virtually the same level as in 1980.

India's heavy reliance on coal, much of it low-quality, goes a long way towards explaining the country's relatively high carbon intensity level. Indian economic policies such as high import tariffs on high-quality coal and subsidies on low-quality domestic coal also have contributed to increased

use of low-quality coal, although initiatives to encourage the use of higher-quality coal, such as reducing the tariff on imported coal, may help in reducing the country's carbon intensity. The introduction and adoption of technologies to reduce coal consumption and/or improve the efficiency of the coal that is combusted is an important government priority, given that the majority of India's power generation is coal-fired.

Renewable Energy

Despite a trend towards urbanization, more than 70% of India's population still lives in rural areas. As the Indian economy develops, one of the greatest challenges that India's local and regional governments face is providing people in rural areas with access to energy. Renewable energy projects - in the form of solar-, wind-, and hydropower-generated electricity - are the key to providing rural areas with energy where power is in short supply. In addition, replacing coal- and other fossil fuel-generated electricity supplied to India's cities with energy from renewable energy sources could aid in reducing air pollution and help to meet the growing energy needs of the country's large metropolises as well.

India is the only country that has a separate government ministry exclusively for non-conventional energy sources, and India has one of the largest national programs to promote the use of solar energy. Whereas the majority of developed countries have turned to solar energy mainly out of concern about the environment and energy security, the use of solar power in India is being advocated as a way to provide energy to regions where there is a shortage of electricity. Rather than build new, expensive generating capacity or connect rural areas to the existing power transmission infrastructure, India is turning to the use of solar energy. In many small villages and remote areas, solar photovoltaic systems are far more cost-effective than conventional energy.

Wind-generated energy is also an important component of India's strategy to boost the use of renewable energies. India is rich in wind energy potential, and the country has been adding installed wind power capacity at an impressive rate. According to the Ministry of Non-Conventional Energy Sources, India now expects to exceed its target of installing 1,500 MW of wind power in the 2002-2007 period. The improvement in grid connections, which have previously slowed the development of wind power in India, as well as an effort to provide incentives to wind-power producers, has spurred the growth of the wind energy industry in India.

Nevertheless, at the same time that small- and micro-level wind and solar energy projects are taking shape, the Indian government is looking to large-scale hydroelectric plants to meet its future energy needs. India has an estimated hydropower potential of 150,000 MW, but hydropower's share of India's energy consumption and production has declined in the past 20 years. Indeed, according to Indian Prime Minister Atal Bihari Vajpayee, the share of hydropower in the country's total installed generating capacity, which was over 40% about 20 years back, has fallen to 25%. Power Minister Anant Geete has said that only about 23% of India's hydropower potential has been exploited. India's state-owned National Hydroelectric Power Corp. (NHPC) is planning to commission 1,090 MW of capacity by mid-2004, ending a protracted period of lackluster growth, and the government hopes that subsidies to support hydropower plant development will help it attain a goal of building 50,560 MW, almost tripling the country's current installed hydropower capacity.

Environmental Outlook

India faces significant challenges in balancing its increased demand for energy with the need to protect its environment from further damage. Sheer population growth and urbanization make the task all the more difficult for the Indian government, as increased vehicular ownership will contribute to existing air pollution problems and urbanization raises the health risks from that pollution. A rapidly increasing population also will lead to an increase in electricity demand, taxing

the already straining power generation, transmission and distribution infrastructure and putting pressure on the power sector to add new capacity to the system. Already, shortages of electricity have hampered India's industrial growth.

As such, electricity is one of the keys to both India's economic development and its environmental protection efforts. The Indian government has introduced initiatives aimed to discourage firms from generating electricity using older, inefficient coal-fired plants, and it has reduced subsidies on low-quality coal. The government has used fiscal incentives, in the form of customs waivers and soft loans, to encourage the installation of pollution abatement equipment, and market mechanisms such as user charges, deposit refund systems, marketable permits and taxes for implementing pollution measures also are being contemplated. In August 2003, India's Supreme Court laid down the principle of "polluter pays."

India has made significant efforts in the field of environmental protection, developing environmental standards for both products and processes, requiring environmental impact statements in certain areas, and introducing environmental audits. India's strong support of air quality and alternative fuel initiatives has brought progress as well as growing pains to the country. However, in the absence of coordinated government efforts, including stricter enforcement, air pollution is likely to continue to worsen in the coming years as urbanization picks up pace and vehicle ownership increases. The Indian government's ability to safeguard the country's environment will depend on its success in promoting policies that keep the economy growing while providing adequate energy needs to satisfy the populace's growing energy consumption requirements in a sustainable manner.

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